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IMPACT OF WEATHER ON AVIATION #2

Winds and Peak Operating Hours

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Winds and Runway Orientation

Runway orientation can intensify the effect winds will have on aircraft in the airport environment. A detailed study conducted by Jerry McDuffie for Arcata Airport, along the northern California coast, points this out well. The Arcata Airport field elevation is 218 feet. The main runway is oriented 140 to 320 degrees. A much shorter runway is oriented from 10 degrees to 190 degrees. There are several high peaks to the east of the airport, while the ocean lies immediately to the west.

When southerly surface winds of 15 knots or more persist for an hour or two, pilots must land from the northwest (aircraft land into the wind whenever possible). Frequently, they encounter light to moderate turbulence. In some cases, aircraft are unable to land.

There appear to be two reasons for the turbulence. Shortly beyond the northwest end of the runway, there is a 200 foot drop-off to the ocean. Winds from the southeast are affected by the drop-off, which sets off a miniature leeside wind effect as eddies are created over the drop-off. This can lead to high sink rates in the air above the drop-off, which pilots may interpret as turbulence, plus a small area of actual turbulence above the drop-off. A few miles upstream, the coastline curves westward sharply, causing an abrupt barrier. Winds from due south and the southwest are affected by barrier. These set up eddies which result in turbulence above the barrier.

Both the drop-off and the barrier lie along the approach path to the main runway. A 15 knot southerly component appears to be the trigger for creating large enough eddies from these terrain features to affect approaching traffic.

Crosswinds and Headwinds

Runway layouts can provide you with an idea of the site's prevailing wind. Since aircraft take off and land into the wind, airport designers try to arrange the main runway (which is usually the site's longest runway), according to the site's prevailing wind direction. This is done to maximize headwind, which is the wind component blowing 180 degrees to the line of flight, and minimize crosswind, which is the component at right angles to the headwind.

Airport runways are laid out according to magnetic compass headings and are numbered according to the compass direction. For example, the east-west runways at Phoenix are 8 and 26. Runway 8 is a magnetic compass heading of 080 degrees. An aircraft landing on 8 would be making his final approach over downtown Phoenix flying a compass heading of 080 degrees.

The forecast wind direction is important to pilots, especially when strong winds are expected. This is especially true when going into an airport which only has one runway--or even sites with two runways, if they are parallel. The forecast direction and speed will determine how much, if any, crosswind the pilot should expect to have on approach or departure.

Each type of aircraft has its own maximum demonstrated crosswind, indicating how much of a crosswind the plane can safely handle. Many general aviation aircraft, including some high-powered twin-engine planes, only have a demonstrated maximum crosswind capability of 15 knots. The true limiting factors on the amount of crosswind which can be handled are gustiness, runway condition, pilot experience, and pilot ability. Figure 1 demonstrates how to determine crosswind components for any aircraft.

Note: Forecast winds are relayed in terms of true north, while pilots use magnetic north when flying. Winds relayed to the pilots advisory radio frequencies, e.g. tower, FSS, and UNICOM, are given in terms of magnetic north. Most pilots are aware of these differences, which are stressed in pilot training and FAA examinations.

Various Wind Problems

Even sites "blessed" with VFR conditions most of the time can become weather sensitive when wind problems arise. For example, the greatest concern at McCarran International Airport in Las Vegas is with high winds--a not uncommon event. The main runway at McCarran is oriented east-west. Any northerly wind greater than 10 knots results in a crosswind of at least 10 knots and a headwind near 0 knots. As a result, McCarran air traffic controllers routinely switch aircraft to the much shorter north-south runway whenever northerly winds greater than 10 knots occur, in order to reduce crosswind and increase headwind components.

Both wind direction and wind speed become critical at high speeds. Under these conditions, not only will the patterns for take-off/approach be dependent on the wind direction, but some aircraft may be unable to fly into or out of the airport due to the high speeds. For light aircraft, 25 knot winds from any direction may be all the pilot can handle. At 35 knots, pilots of all aircraft--including large corporate jets and air carriers, need to watch the winds closely. At these speeds, crosswinds beyond the maximum allowable amount for the aircraft, high headwinds, and moderate or greater mechanical turbulence all become problems.

Peak Operating Hours

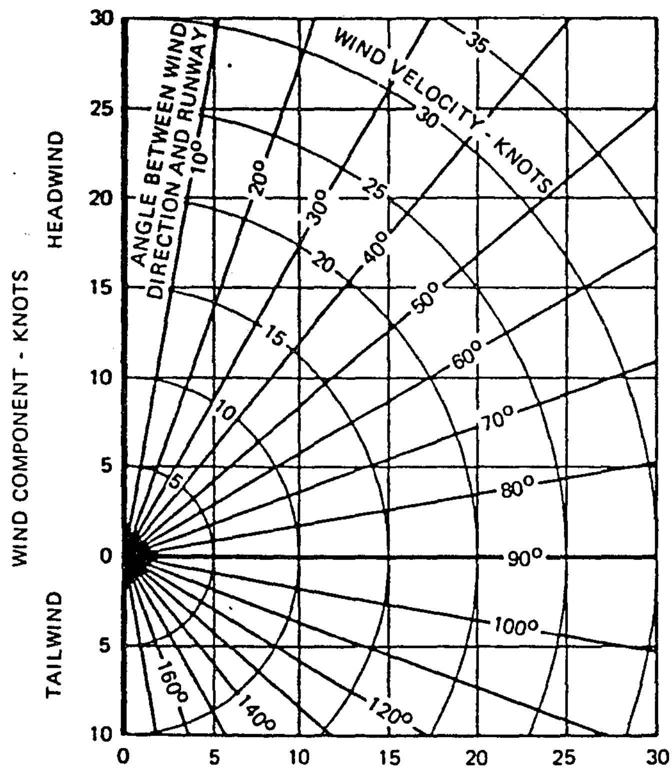
Most of the airports for which terminal forecasts are issued have peak hours. Airports with mostly business/commercial traffic usually experience peak hours in the early mornings (between 7 and 10 a.m.) and late afternoons (between 5 and 7 p.m.). Airports which cater to general aviation are more likely to experience peaks based on sun time: between one and three hours after sunrise and during the two hours preceding sunset. Some airports have peaks which vary depending on whether it is a weekday or weekend, with mostly corporate flights during the week and pleasure flights on the weekends.

Why is it important for NWS aviation forecasters and briefers to be aware of peak times? Those are the times when accurate forecasts are most critical, since more aircraft will be affected by the forecasts. Weather delays cause the most havoc during peak times, so the farther in advance information can be provided on conditions expected to change during the peak periods, the better.

Impact of Weather on Aviation #2 - Figure.1

WIND COMPONENTS

NOTE:
Maximum demonstrated crosswind velocity is 15 knots (not a limitation).



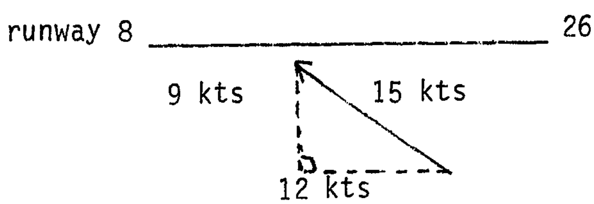
<u>Example</u>

Assume landing at Phoenix runway 8 with reported winds (magnetic north) of 120 degrees at 15 knots.

1. Determine the angle of the runway to the winds. In this case the angle between the runway (080) and the wind (120) is 40 degrees.

2. Find the angle/wind intersection on the chart. In this case, find where the 40 degree line crosses the 15 knot arc.

3. Use the intersection to find the headwind and crosswind. From the intersection found in 2 above, move across to the left to find the headwind (12 knots) and move down to find the crosswind (9 knots).



You can verify that the figures are correct by using simple trigonometry. Since the headwind and the crosswind blow at right angles to one another, the sum of their squares will equal the square of the wind speed.